

Beginning in 2015, the Spruce and Peatland Responses under Climatic and Environmental Change (SPRUCE) climate change experiment (<http://mnspruce.ornl.gov/>) in Northern Minnesota, USA, will expose 13 m diameter plots of an ombrotrophic *Picea mariana* – *Ericaceous* shrub – *Sphagnum* bog ecosystem to long-term temperature × CO₂ treatments. Treatments are expected to change soil water availability, vapor pressure deficit, photosynthesis, respiration, evapotranspiration and relative species composition. We examined pre-treatment ecophysiology of *Picea mariana* (black spruce) including seasonal assessment of cohort specific light-saturated assimilation rate (A_{max}), maximum electron transport rate (J_{max}), maximum carboxylation capacity (V_{cmax}), respiration and their temperature response functions. In addition, we assessed diurnal and seasonal patterns of sap flow and species-specific patterns of water potential. Granier-style thermal dissipation probes (TDP) were calibrated *in situ* by cutting instrumented trees and measuring their actual water uptake. We also assessed spruce hydraulic conductivity under drying conditions in excised roots, branches and foliage using vulnerability curves and pressure-volume curves.

Photosynthetic capacity increased as the season progressed, and peaked by late summer, with the 1-2 year old cohorts contributing more than new needles to modeled total C uptake. V_{cmax} and J_{max} were not responsive to T in the spring, however, by August they were highly sensitive to T, with optimal T peaking between 35-38°C, slightly higher than current maximum summer air T. The SPRUCE experimental treatments will push air T up towards 45°C in some plots, which will allow us to test foliar capacity for biochemical T acclimation. Sap flow began by late May and was fairly constant over the season until declining in mid-September and ceasing as temperatures dropped below zero. The *in situ* calibrations improved sap flow estimates, and illustrated substantial hysteresis in sap flow due to release of stored water in larger trees. Midday mean summer ψ was -1.5 MPa for spruce foliage, higher than the co-occurring *Larix laricina* (larch), which was -2.0 MPa. Laboratory measurements indicated specific leaf conductivity of spruce declined as drought stress increased beyond -1.2 MPa, with the average turgor loss point (TLP) reached by -2.5 MPa, lower than the TLP of larch (-1.95 MPa). While summer spruce ψ remained higher than the TLP, larch often reached the TLP indicating substantial loss of hydraulic conductivity on a daily basis, indicating potential for shifts in community composition due to treatment effects on net carbon uptake and differential water stress among the species.